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Oil Price Shocks, Asymmetric Effect and Volatility Spillover; Case of Stock Market in Oil Exporting Countries

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ABSTRACT

This research analyzes the dynamic relationship between oil price changes and thestock market for the five main net oil exporting countries, namely Iran, Russia, Saudi Arabia, Norway and United Arab Emirates using weekly data from 16/1/2006–15/6/2011. The current study also estimate unrestricted multivariate Vector Auto regressions (VAR) model with 4 parameters (stock market return, oil domestic price changes, industrial production growth and world market return) as well as the impulse response function and variance decomposition. Moreover, the bivariate BEKK GARCH (1, 1) model is used to show the impact of oil price volatility spillover on stock market volatility. The results reveal that three countries, Russia Iran and Saudi, out of the five researched are sensitive to the oil price shocks and volatility spillover. Furthermore, there is strong evidence of asymmetric effect of oil on the Iranian and Saudi markets. The results presented here may facilitate improvement in future studies about models on risk evaluation of oil exporting markets.

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1. Introduction

Following the oil embargo, in 1972, a large and growing body of studies has investigated the oil price shocks-macroeconomic nexus. There is evidence that oil, as the most essential source of energy, plays a key role in the world economy. Hamilton (1983) demonstrated that most US recessions have proceeded by a dramatic and unexpected surge in oil price. Lee, Ni et al. (1995) point out that oil price, under stability, has greater impact on GNP. Eika and Magnussen (2000) indicate that employment and growth rate in Norway are positively responsive to the oil price shocks. Mallik and Chowdhury (2011) reported that oil price volatility leads to uncertainty on Australian inflation. Bloom (2013) claims that not only do the oil price shocks and financial panics lead to a higher uncertainty during the recession period, but they also cause a considerable decrease on growth and investment. Macroeconomic fundamental-volatility prediction formed the central focus of a study by Engle, Ghysels et al. (2013) in which the authors found that the aforementioned elements had played a pivotal role in forecasting both long term and short term volatility.

Oil price variation exerts a powerful effect upon macroeconomic performance through inflation, unemployment, recession and growth; thereby, an unexpected variation on oil price has profound consequences for financial sectors and equity markets. The theory of market efficiency provides a useful account of how shocks and market return are correlated. This definition takes to the account the changes on expected return of market which are caused by news and innovations. In the other words, covariance among news is known as a major source of unexpected variance in stock market returns. On the other hand, homogeneity of explanatory variables, that predicts equity market returns, indicates that current news account for source of changes on expected returns and cash flows. This definition is in line with the one suggested by Campbell (1990) according to which shocks to the expected future returns are mostly and negatively significant in correlation to the shocks in future expected dividends. Alternatively, the most likely cause of the oil price shocks can be transmitted by the changes in input cost of productions. This issue brings about a lower productivity in labor and capital. Furthermore, as far as costumer's disposable income is concerned, surge in oil price as an energy source decreases the demand for goods. However, the response of shares in different industries might be heterogeneous. It can be explained by the fact that industries are characterized by different intensive oil production processes (Bastianin and Manera (2015) and Lee, Kang et al. (2011)).

Up to now, several studies have explored different aspects of the relationships between oil price and equity market performance. In a follow-up study, Kaneko and Lee (1995) found that stock market returns are affected by the shocks resulting from oil price. This finding is consistent with whatHuang, Masulis et al. (1996), Jones and Kaul (1996) and Papapetrou (2001) have found in their studies which points out that an increase in crude oil price generates a negative stock market return. Despite prior evidence, Hammoudeh and Choi (2006) argue that most of GCC markets are positively affected by the oil price shocks. Hammoudeh, Dibooglu et al. (2004) and Guidi, Russell et al. (2006) have highlighted the role of OPEC decisions on the stock market return. Hammoudeh and Choi (2007) stressed that countries in higher level of oil dependency, as a ratio of government revenue, and openness are much sensitive to the news from oil and international financial markets. It has been inclusively shown by Driesprong, Jacobsen et al. (2008) that for the period of 1973 to 2003, oil price variations have a predictive power on stock market return changes in 18 different countries.

A part of investigations (e.g. Bastianin and Manera (2015), Kang and Ratti (2013), and Kilian and Park (2009) has attempted to draw fine distinctions between different sources of the oil price shocks. The origin of the oil price shocks is defined by three sub groups of demand oil price shocks, supply oil price shocks and aggregate oil price shocks. Kilian and Park (2009) discuss that shocks from aggregate demand are the sources of positive excess return on the US market. In the same vein, Degiannakis, Filis et al. (2013) believe that the oil price surges, that are driven from aggregate demand, induce higher volatility on the European equity markets. Cunado and de Gracia (2014) show that recognition of the oil price shocks is a principal determining factor of stock market reaction. Bastianin and Manera (2015) trace the reaction of market volatility to the shocks in Japan, USA, Canada and Norway. It is shown that supply of the oil price shocks leads to a higher fluctuation in the market volatility in these countries. This finding is in contrast with that of Maghyereh (2004) who stresses the role of energy intensity in sensitivity of market return to the shocks. Similarly, Aloui, Nguyen et al. (2012)note that oil dependency of economy is a principal determining factor of stock market responses to the oil price shocks in emerging markets.

In a well-known study, Sadorsky (1999) argues for asymmetric effects of the oil price shocks on the US stock market. He believes that positive oil price shocks, compared to a fall in oil price, cause a larger proportion of variation in the stock market. Similarly, this view is supported by later studies on the market behavior by Basher and Sadorsky (2006), Cong, Wei et al. (2008), Park and Ratti (2008), Bjørnland (2009) and Lee and Chiou (2011). Basher and

Sadorsky (2006) proposed a nonlinear approach in their investigation on emerging stock markets. Park and Ratti (2008) observed only a strong asymmetric response among stock markets of the US and Norway. Research finding by Bjørnland (2009) also reveals the same asymmetric response in the Norway stock market.

Many studies are proposed to explain the linkage between oil price and stock market at the industrial level. Faff and Brailsford (1999) and Sadorsky (2001) demonstrated the significance of positive sensitivity in industry equity return of oil and gas sectors. In their study Hammoudeh, Dibooglu et al. (2004), show that future oil price contracts are impressed by the echoing effect of industry level index of oil industries. In 2006, Nandha and Faff demonstrated that in the long run, rather than short run, a greater number of sectors show sensitivity to the oil price shocks. Cong, Wei et al. (2008) indicate that there is no evidence in the asymmetric effect of the oil price shocks on the industrial level, in contrast, the study of Nandha and Faff (2008) on 35 industries indicates that oil price changes have an asymmetric effect on the returns in a global view. According to an investigation by Jimenez-Rodriguez (2008), industries, which are more related to the personal consumption, are less affected by the oil price shocks. Oberndorfer (2009) presents that predictive oil price volatility has a negative impact on oil and gas stocks. Lee and Chiou (2011) examined the asymmetric impact of the oil price shocks through the industrial level performance of Chinese stock market return. More recently, He and Casey (2015) found binominal linkage among the investor sentiments, forecasting oil price return and oil company equity returns.

Other authors (Ciner, 2001; Basher and Sadorsky, 2006; Odusami, 2009) question the usefulness of nonlinear approaches in their investigation. Ciner (2001) argues that there is corroborative evidence on causality assessment between oil price and the stock market return in non-linear models. Sadorsky (2006) reported that oil price risk plays a critical role in the behavior of emerging stock market. In another study by Odusami (2009), a jump in the US equity market formed the central focus in which the author found that a variation in the crude oil price had important repercussions for the jump distribution in the stock market return. Narayan and Sharma (2011) explained a nonlinear linkage between oil price variation and sector return of New York stock exchange.

Although there were many researches about stock market performance and oil price, few of them focused on oil exporting countries. Furthermore, the limited number of studies conducted on the markets of oil exporting countries indicates that they have mostly concentrated on GCC

equity markets. However, these findings could not be considered as a benchmark for the stock market behavior in oil exporting countries in dealing with the oil shocks. This is supported by findings of the studies by Malik and Hammoudeh (2007) and Hammoudeh and Choi (2007) revealing that stock markets of GCC countries are highly correlated with each other. Moreover, the researches to date have tended to focus on monthly analysis in their findings, while this study was undertaken to investigate a dynamic overview on weekly analysis of oil exporting equity markets. So far, there are only relatively scanty studies (Nandha and Faff, 2006; Bastianin and Manera, 2015) which interchangeably employed both US dollar and domestic crude oil price in their investigations. By considering that equity market indices are identified in their national currency, domestic price of crude oil allows for capturing the effect of exchange rate fluctuation in our study. The current study contributes to our knowledge by addressing four important issues. Firstly, to ascertain the effect of oil price return shocks on the stock market return. Secondly, to determine symmetric or asymmetric response of oil exporting financial market to the oil price shocks. Thirdly, to investigate the oil price return volatility spillover on the stock market return. Finally, to examine the importance of exchange rate in dynamic reaction of stock market returns.

The rest of the paper is organized as follow: in section 2, the data source, the description and modifications are presented. Section3includes the methodology as well as time series properties. Section 4 is devoted to the empirical findings on dynamic study of oil and stock market. Finally, section 5 consists of the conclusion and implications.

2. Data sources and parameter identifications

In this section, the sample period, data sources and the variable identification are described. Our sample contains five major net oil exporting countries in 2011, namely Saudi Arabia, Russia, Norway, Iran and United Arab Emirates (Stout, 2012). The data consists of weekly indexes for stock market, crude oil price, world market return and oil production. The experiments were conducted over the course of a growing period from 15.01.2006 to 15.06.2011, having a total of 265 observations in our investigations. Data stream is used as the data source of; crude oil of Brent per barrel (OP), financial times and London stock exchange 100, FTSE100, as proxy for world market return (WMR) and exchange rate of US dollar to domestic currencies in all countries. The crucial point in our data is that the weekly data are included in our estimations, while the working days in sample countries are not homogenous, for instant; Iranian stock exchange work from Saturdays to Wednesdays, Saudi and UAE stock exchange weekly trading days are Sundays to Thursdays and finally, Russian and Norwegian stock exchange follow Monday to Friday trading days. On the other words, just three days of Monday, Tuesday and Wednesday are in common working days among our sample countries, due to of reliability in comparative finding Tuesday stock market index is implemented in our return calculations. For this purpose, market index of Tuesdays is adopted as benchmark of stock market index in week; this approach was previously applied by Hammoudeh and Choi (2006). Tuesdays are much advantaged in comparison to the Wednesdays and Mondays since, Mondays and Wednesdays are affected by the impact of beginning and closing working day in some countries. The same approach for similarity among variables is employed on crude oil price, exchange rate, and world market index and oil production. The percentage changes in volume of oil production are utilized as a proxy for oil supply shocks.

As it is shown by theHerrera, Hu et al. (2014) spot crude oil price shows a high frequency performance, and persistence of noisy data may lead to exaggerated volatility of oil price return. In order to avoid the aforementioned consequence, one month forward rate of crude oil of Brent is employed in estimations. Different authors have measured crude oil price shocks in a variety of ways. Hamilton (1983) introduced oil price changes (COP) as natural logarithms difference of two according periods. In a later study, Mork (1989) introduces an oil price increase (OPI) specification by making some changes in COP definition. The main distinguish between OPI and COP is that OPI specifies a zero value to log differences, when crude oil price at time t is less than t+1.The scaled oil price increases (SOPI) is innovated by Lee, Ni et al.

(1995), and in line with this approach,Hamilton (1996) identifies net oil price increases (NOPI) by justification on SOPI. Davis and Haltiwanger (2001) implemented a different formula in oil price shock identifications. According to their definition, the oil price shocks are logarithmic differences of a fraction for two following periods. In their fraction, the oil price shocks are calculated as ratio of real oil price that is divided by the weighted arithmetic mean of 20 former periods. In another approach, Guo and Kliesen (2005) squared oil price changes in their investigation. In this study, oil price return in us dollar (COP) and oil price return in domestic currencies (CODP) are interchangeably employed in an analysis. By the rest of the article, IP is used an indicator for oil production growth. Moreover, COP and CODP show Crude oil price return in US dollar and crude oil price return in domestic currency, respectively. Furthermore, the stock market return and world market return in FTSE 100 are abbreviated as STR and WMR, respectively. All returns and growth terms in the empirical section of the current study are defined by the logarithmic difference of two consecutive periods.

3. Methodology

In this section of the study, the empirical approaches are attempted to be described. A multivariate vector auto regressive model is adapted to evaluate the effect of oil price return shocks and the asymmetric response of the stock market. Additionally, bivariate BEKK (1, 1) GARCH is chosen to provide detailed understanding of oil price return volatility spillover on volatility of equity markets. By the rest of this section, the methodology and model identifications are explained under three headings of VAR and model specification, Bivariate BEKK GARCH and time series properties.

3.1. Multivariate Vector Auto regressive model (VAR) and model specification

In this framework, the variables are function of their own lags and lags of the other variables. The VAR characteristic makes it possible to examine the dynamic reaction of dependent variables to unexpected changes on variables. To date, many studies (Gjerde and Saettem, 1999; Rapach, 2001; Apergis and Miller, 2009) have utilized this model to quantify and examine the magnitude impact of individual macro shocks as a source of observable variation to the other variables. The multivariate VAR was used due to of investigation capability on the dynamic interrelationship among variables. Furthermore, Nandha and Faff (2008) emphasize on characteristic stability in VAR findings. Equation-1 illustrates VAR models.

$$X_t = A_0 + \sum_{i=1}^{p} \mathrm{A_i X_{t-i}} + \varepsilon_\mathrm{i} \qquad \textit{Equation 1}$$

X_t is n×1 matrix of n variables where $A_1, A_2, \ldots, A_p$ is n×n matrix of coefficient of previous lags.ε_i is column of disturbance vector of variables with following characteristics;

$$E(\varepsilon_i) = 0 \ \ forallnequations\ , \ \ ifl = mE(\varepsilon_l, \varepsilon_m) = \Omega$$
$$ifl \neq mE(\varepsilon_l, \varepsilon_m) = 0$$

Ω is variance-covariance of matrix of error terms. It is assumed that there is no serial correlation amongε_i, however, it is possible that error terms of equations are contemporaneously correlated. The estimation of coefficients in VAR system does not provide adequate evidencesin the dynamic analysis of variables. For this purpose, impulse response function and forecast error decomposition are well established approaches.

Tracing out the reaction of any variables in the system to the one standard deviation shocks in other variables can be helpful in assessing the responses of the interested variables to the shocks. The structural impulse response functions (IRFs) are the plots of $\theta_i$against s for

i= 1, 2, 3 …, s.

$$X_{t+s} = \mu + \theta_i \varepsilon_t + \theta_{i+1}\varepsilon_{t+1} + \cdots + \theta_{i+s}\varepsilon_{t+s} \qquad \textit{Equation 2}$$

The plots give a summary how unit impulses of the structural shocks at time ***t*** impact the level of X at time $\boldsymbol{t+s}$for the different value of the ***s.*** Framework of VAR model includes a system of equations which traces out innovations impact through impulse response functions.

Another way in interpreting the dynamic effect of oil price on the stock market is forecast error variance decomposition (Variance decomposition). Utilizing VDCs of VAR model variables is a useful way to investigate how different endogenous variables shocks impact are transmitted to the variation of following horizons aftershocks. Variance decomposition can be shown by below mathematical notations in VAR equations 3 to 5 where Ω is variance –covariance matrix and ϕ is coefficient matrix of lag;

$$x_{t+s} = \phi^s x_t + \phi^{s-1} u_{t+1} + \cdots + \phi u_{t+s-1} + u_{t+s} \qquad \textit{Equation 3}$$
$$\hat{x}_{t+s} = E(x_{t+s}|x_t, \ldots, x_1) = \phi^s x_t \qquad \textit{Equation 4}$$
$$e_s = x_{t+s} - \hat{x}_{t+s} = u_{t+s} + \phi u_{t+s-1} + \cdots + \phi^{s-1} u_{t+1} \qquad \textit{Equation 5}$$

Forecast error variance-covariance matrix of Ω in s period of ahead is written in term of orthogonaliezed innovations by:

$$Var(e_s) = \sum(s) = \Omega + \phi\Omega\phi' + \cdots + \phi^{s-1}\Omega\,(\phi')^{s-1} \qquad \textit{Equation 6}$$

It is explained that X_t is n×1 matrix of included variables in the model, used for answering two of the objectives; firstly, the effect of oil price return shocks on the stock market return and secondly, examining the asymmetric effect of oil price return shocks on the stock market return. In the first model, X_t matrix contains four variables of oil price return (COP), industrial production growth (IP), world market return (WMR) and stock market return (STR). In parallel, in a same model, crude oil in domestic price return (CODP) is replaced by COP.

$$X_t = [STR \quad COP \quad WMR \quad IP] \qquad \textit{Equation 7}$$

For the second objective, i.e., the asymmetric effect of oil price return shocks on equity market return, oil price return (COP or CODP) in equation-7 is decomposed into the positive and negative oil price changes as follow;

$$X_t = \left[STR \quad COP_t^+ \quad COP_t^- \quad WMR \quad IP_t\ \right] \qquad \textit{Equation 8}$$

Where:

$$COP_t^+ \ when \quad COP_t - COP_{t-1} \geq 0$$
$$COP_t^- \ when \quad COP_t - COP_{t-1} < 0$$

It is also necessary to mention that the same approach as follow is employed on crude oil price return on domestic currency (CODP).

3.2. Bivariate BEKK GARCH

Bivariate BEKK GARCH (1, 1), introduced by Engle and Kroner (1995), is adopted to quantify the volatility spillover of oil price return on the equity market return. Bhattacharya, Singh et al. (2006) identify efficient estimation, positive definite of covariance matrix and stability of findings are several advantages of this model. Plenty of studies have used bivariate BEKK GARCH (1,1) to examine dynamic interactions of shocks and conditional variances of time series (Cronin, Kelly et al., 2011; Chung, 2008; Karanasos and Kim, 2005).
The mean equations of both oil price and the stock market return are given by Equation-9:

$$\mathrm{R}_{\mathrm{i,t}} = \mu_{\mathrm{i}} + \rho\ \mathrm{R}_{\mathrm{i,t-1}} + \varepsilon_{\mathrm{i,t}} \qquad \text{where} \quad \varepsilon_{i,t} \sim N(0, H_t)$$ *Equation 9*

Where $\mathrm{R}_{\mathrm{i,t}}$ represents the stock market return or oil price return at time t, μ_i is the long run drift of equation and $\varepsilon_{i,t}$shows the error term. Bivariate BEKK model of GARCH (1, 1) is shown by;

$$\mathrm{H}_{\mathrm{t}} = \mathrm{C}'\mathrm{C} + \mathrm{G}'\mathrm{H}_{\mathrm{t-1}}\mathrm{G} + \mathrm{A}'\varepsilon_{\mathrm{t-1}}\varepsilon'_{\mathrm{t-1}}\ \mathrm{A}$$ *Equation 10*

Where H_{t}isa matrix of conditional variance at time t and captures the GARCH effect in the model. C in the bivariate model is lower diagonal 2×2 matrics. G in the model captures the relationship between lag-lead variances(coefficient of GARCH effect) of two series which is shown by 2×2matrix. The role of A as a 2×2 matrix is to transmit the magnitude impact of shocks and unpredictable events (ARCH effect) of latter period into former period conditional variances.

$$A = \begin{bmatrix} a_{ss} & a_{so} \\ a_{os} & a_{oo} \end{bmatrix} \mathrm{G} = \begin{bmatrix} \mathrm{g_{ss}} & \mathrm{g_{so}} \\ \mathrm{g_{os}} & \mathrm{g_{oo}} \end{bmatrix} C = \begin{bmatrix} c_{ss} & c_{so} \\ c_{os} & c_{oo} \end{bmatrix}$$

In our study, the conditional variance of the stock market return, by considering the lags effect of shocks and volatility of the stock market return and oil price return, can be shown as;

$$\mathrm{H}_{\mathrm{ss}} = \mathrm{C}_{\mathrm{SS}} + \left(\mathrm{a}_{\mathrm{ss}}\varepsilon_{\mathrm{ss,t-1}} + \mathrm{a}_{\mathrm{os}}\varepsilon_{\mathrm{os,t-1}}\right)^2 + \left(\mathrm{g}_{\mathrm{ss}}\mathrm{h}_{\mathrm{s,t-1}} + \mathrm{g}_{\mathrm{os}}\mathrm{h}_{\mathrm{o,t-1}}\right)^2$$ *Equation 11*

Where a_{ss} and g_{ss} are accordingly coefficients of lag-lead relationship of shocks and volatility on the stock market return volatility. Moreover, a_{os} captures the impact of shocks in oil market on volatility of the stock market return and g_{os}shows spillover of oil price return volatility on the stock market return volatility. The maximum likelihood estimation is used in the current study under the assumption of conditional normality in order to estimate matrices element of BEKK GARCH (1, 1) model by RATS. Furthermore, two oil price identifications, namely

domestic price of oil per barrel and US dollar price of oil per barrel, are introduced in volatility of each stock market return.

3.3. Time series properties

Reliability of the findings of time series analysis is highly dependent on stationary of included variables in models. In this case, three unit root tests are employed, namely Augmented Dickey-Fuller (1979) ADF test, modified Perron Ng and Perron (2001) Modified PP test and Kwiatkowski et al. (1992) KPSS tests. The null hypothesis is non-stationary in ADF and PP while it is stationary of variable in KPSS. Findings of ADF test are size distorted and are biased on series with break points. For robustness in stationery of series, two additional tests of PP and KPSS are employed.

Choosing the appropriate number of lags in the VARs model has a vital role in the findings. It indicates that cointegration test of nonstationary variables in VAR estimation is highly sensitive to the number of variables lag in the test. In order to stand off possible problems, two tests of Akaike Information Criterion (AIC) and Final Prediction Error (FPE) are utilized in the research for double checking and accurate optimal lag identification in the system of equations.

4. Empirical results

Primary checking of properties of time series is a necessary part of any imperial in the aforementioned models. The developed results of unit root test by Dickey and Fuller (1979), Kwiatkowski, Phillips et al. (1992) (KPSS) and Ng and Perron (2001) (PP) are shown in Table 2.

From the test results in Table 2 we can see that all variables are stationary and are not I(1). Furthermore, there is no need for cointegration test among the variables since none of variables is unit root. The results of FPE and AIC tests in Table 1 show the optimum number of lags included for variables in each VAR system. The findings of the optimum lag identifications are explained as examples for interpretation of Table 2. For example, all four specified VAR models of Iranian stock market are estimated by 2 lags for the variables.

Table 1
Result of optimal lag identification tests

VAR System	FPE	AIC
IRAN(IR)		
(COP, WMR, IR-STR, IP)	2	2
(CODP, WMR, IR-STR, IP)	2	2
(COP^{+}, COP^{-},WMR, IR-STR, IP)	2	2
($CODP^{+}$, $CODP^{-}$,WMR, IR-STR, IP)	2	2
NORWAY(NR)		
(COP, WMR, NR-STR, IP)	2	2
(CODP, WMR, NR-STR, IP)	2	2
(COP^{+}, COP^{-},WMR, NR-STR, IP)	3	3
($CODP^{+}$, $CODP^{-}$,WMR, NR-STR, IP)	2	2
RUSSIA(RU)		
(COP, WMR, RU-STR, IP)	1	1
(CODP, WMR, RU-STR, IP)	1	1
(COP^{+}, COP^{-},WMR, RU-STR, IP)	2	2
($CODP^{+}$, $CODP^{-}$,WMR, RU-STR, IP)	2	2
SAUDI ARABIA(SA)		
(COP, WMR, SA-STR, IP)	2	2
(CODP, WMR, SA-STR, IP)	3	3
(COP^{+}, CDP^{-},WMR, SA-STR, IP)	3	3
($CODP^{+}$, $CODP^{-}$,WMR, SA-STR, IP)	3	3
United Arab Emirates (U.A.E)		
(COP, WMR, UAE-STR, IP)	1	1
(CODP, WMR, UAE-STR, IP)	5	5
(COP^{+}, COP^{-},WMR, UAE-STR, IP)	2	2
($CODP^{+}$, $CODP^{-}$,WMR, UAE-STR, IP)	5	5

Table 2
Result of unit root test

		ADF		KPSS		PP	
	Variables	**Intercept**	**Intercept and trend**	**Intercept**	**Intercept & trend**	**Intercept**	**Intercept & trend**
IRAN	**COP**	-16.6517***	-16.64416***	0.10189	0.06311	-16.8255***	-16.8147***
	COP+	-17.8540***	-17.92090***	0.29911	0.10005	-17.8436***	-17.9229***
	COP-	-6.19467***	-6.317405***	0.31917	0.09469	-16.8800***	-16.9597***
	CODP	-19.6469***	-19.62238***	0.10623	0.07876	-69.9158***	-69.8876***
	CODP+	-7.65105***	-8.450616***	0.97177	0.20655	-23.112***	-23.5741***
	CODP-	-6.68511***	-7.330728***	0.8128	0.15765	-23.5654***	-23.6727***
	STR-IR	-6.94100***	-7.222871***	0.35187*	0.05002*	-11.0201***	-11.1776***
	WMR	-17.4049***	-17.40863***	0.15839	0.09693	-17.4327***	-17.4320***
	IP	-8.76297***	-8.777974***	0.04578	0.03849	-14.9386***	-14.9170***
Norway	**COP**	-17.0716***	-17.0658***	0.115792	0.070259	-17.0926***	-17.085***
	COP+	-17.8951***	-17.9047***	0.180364	0.089321	-17.9281***	-17.9431***
	COP-	-3.26541***	-3.27533***	0.300541	0.103041	-17.9721***	-18.0098***
	CODP	-20.5382***	-20.5169***	0.157515	0.091353	-67.8800***	-67.9376***
	CODP+	-9.46489***	-9.83134***	0.599065*	0.238329*	-23.2454***	-23.6579***
	CODP-	-7.69019***	-8.01303***	0.526256*	0.141698*	-23.6118***	-23.5576***
	STR-IR	-18.5429***	-18.5560***	0.187687	0.109192	-18.4518***	-18.4727***
	WMR	-17.4049***	-17.40863***	0.15839	0.09693	-17.4327***	-17.4320***
	IP	-12.2034***	-12.1926***	0.078947	0.058703	-12.3830***	-12.3508***
Russia	**COP**	-17.1303***	-17.1099***	0.074473	0.053997	-17.17156***	-17.15188***
	COP+	-17.3757***	-17.4104***	0.227721	0.103141	-17.36928***	-17.39837***
	COP-	-7.06096***	-7.13945***	0.276164	0.097472	-16.59076***	-16.63268***
	CODP	-20.2959***	-20.2647***	0.117079	0.084769	-66.76468***	-66.72209***
	CODP+	-8.64394***	-9.31018***	0.959802*	0.303822*	-23.00638***	-23.67553***
	CODP-	-7.36774***	-7.95439***	0.879306*	0.18093*	-23.44900***	-23.55777***
	STR-IR	-7.50172***	-7.57103***	0.244663	0.116163	-18.68393***	-18.72745***
	WMR	-17.4049***	-17.40863***	0.15839	0.09693	-17.4327***	-17.4320***
	IP	-13.4256***	-13.4150***	0.114449	0.093289	-13.41533***	-13.40263***
Saudi Arabia	**COP**	-16.6269***	-16.6246***	0.106231	0.061682	-16.8388***	-16.8315**
	COP+	-17.8588***	-17.9460***	0.349245*	0.103818	-17.8475***	-17.9508***
	COP-	-6.00730***	-6.14386***	0.324867	0.094569	-16.5149**	-16.6143***
	CODP	-14.2778***	-14.2655***	0.131679	0.113256	-92.5980***	-92.8540***
	CODP+	-11.5537***	-23.1930***	0.905304*	0.145879*	-22.0952***	-22.8110***
	CODP-	-23.7052***	-24.3241***	1.048973*	0.152995*	-22.6991***	-23.7501***
	STR-IR	-16.5587***	-16.5666***	0.158633	0.125778*	-16.6036***	-16.6079***
	WMR	-17.4049***	-17.40863***	0.15839	0.09693	-17.4327***	-17.4320***
	IP	-13.5841***	-13.5885***	0.12552	0.075461	-13.5975***	-13.6023***
UAE	**COP**	-16.6302***	-16.6280***	0.106343	0.06172	-16.8431***	-16.8358***
	COP+	-17.8584***	-17.9461***	0.345255	0.103742	-17.8466***	-17.9502**
	COP-	-23.1330***	-23.6039***	0.880355	0.167823*	-22.2706***	-23.1218***
	CODP	-10.8705***	-10.8406***	0.104823	0.102645	-146.182**	-145.772***
	CODP+	-21.1943***	-21.6701**	0.877177*	0.157975*	-20.8593***	-21.5422***
	CODP-	-23.1330***	-23.6039***	0.880355*	0.167823**	-22.2706***	-23.1218***
	STR-IR	-14.6881***	-14.9403***	0.420956	0.122087*	-15.0313***	-15.1302***
	WMR	-17.4049***	-17.40863***	0.15839	0.09693	-17.4327***	-17.4320***
	IP	-10.7517***	-10.7915***	0.12602	0.060208	-14.0131***	-14.1595***

Note: (***),(**), and (*) are indicators of hypothesis rejection at level of 1%, 5% and 10% significant accordingly, CODP is indicator of oil price return under domestic price, CODP+ is indicator of positive return on oil price in domestic, CODP- is indicator negative returns on oil price in domestic, COP oil price return in US dollar, COP+ is indicator of positive oil price return in US dollar, COP- is indicator of negative oil price return in US dollar , STR is indicator of stock market return, WMR is indicator of world market return and IP is indicator of industrial production growth.

The rest of this section attempts to provide adequate information to answer four major research questions separately under three headings of market return and shocks, symmetric or asymmetric response of the stock market return and volatility transmission.

4.1. Market return and shocks

Figure-1 provides the experimental findings of the stock market return in the sample countries to the shocks from each of variables. These figures confirm the positive association between the oil price shocks and the stock market return in Saudi Arabia, Russia and Iran and do not detect any evidence for significant stock market return reaction to the oil price return shocks under both domestic and US dollar values in Norway and UAE. On the contrary, the study by Gjerde and Saettem (1999) did not find a significant response from Norwegian stock market to the oil price shocks. These differences can be explained in part as a result of oil price identification in domestic oil price shocks. The observed difference between COP and CODP in Figure-1 shows that the oil price shocks under domestic price of crude oil have greater effects on the stock market return. It is also shown that CODP shocks are capable of explaining the market response for a longer period. Among oil exporting countries, Russia stock exchange return shows the highest sensitivity to the oil price shocks, and the positive response of market return remains for 10 weakly horizons. The positive response peak of the stock market return occurs in the first week after shock by 2.5%. The findings of variance error decomposition (Table 4-3) of Iran, Norway, Saudi Arabia and U.A.E indicate that after 16 weeks, less than 10% of stock market return variability comes from shocks to the oil price. However, in case of Russian market, more than 20% of their market return is attributed by the oil price innovations. If compared, the results of variance decomposition of COP and CODP model reveal that larger ratio of variability of market return are explained in CODP model. Surprisingly, a comparison of the oil shocks and shocks to world market reveals that four of major oil exporting countries stock market variability are more explained by the world market shocks than shocks to oil price.

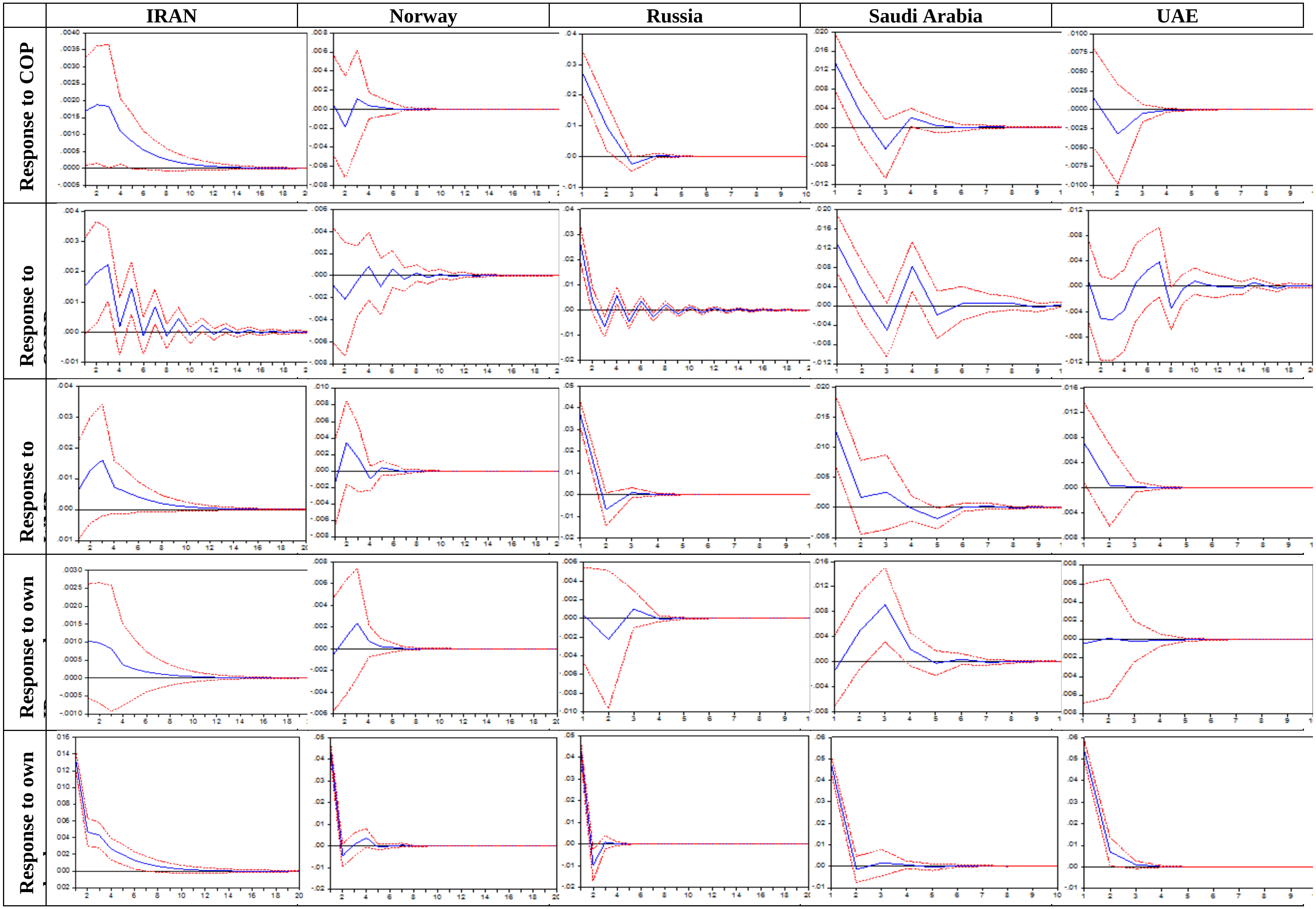


Figure 1

Impulse response function of stock market return to shocks on other variables

Table 1
Generalized variance decomposition

		Period	Oil price return	World market return	Industrial production growth	stock makret return
Iran	COP	1	1.59	0.23	0.59	97.59
		2	3.08	0.99	0.97	94.97
		4	4.54	2.13	1.17	92.15
		8	4.84	2.30	1.18	91.68
		16	4.86	2.31	1.18	91.65
	CODP	1	1.30	0.21	0.52	97.97
		2	3.01	1.05	0.95	94.99
		4	4.66	1.91	1.15	92.28
		8	5.58	2.02	1.16	91.25
		16	5.68	2.02	1.16	91.14
Norway	COP	1	0.01	0.14	0.01	99.84
		2	0.19	0.74	0.06	99.01
		4	0.25	0.90	0.36	98.49
		8	0.25	0.91	0.36	98.48
		16	0.25	0.91	0.36	98.48
	CODP	1	0.04	0.11	0.01	99.84
		2	0.28	0.69	0.05	98.98
		4	0.32	0.92	0.35	98.41
		8	0.40	0.93	0.35	98.32
		16	0.40	0.93	0.35	98.32
Russia	COP	1	19.66	34.58	0.00	45.75
		2	20.74	33.70	0.13	45.44
		4	20.85	33.65	0.15	45.36
		8	20.85	33.65	0.15	45.36
		16	20.85	33.65	0.15	45.36
	CODP	1	17.61	38.54	0.03	43.82
		2	17.66	38.51	0.17	43.66
		4	19.21	37.76	0.18	42.86
		8	20.09	37.32	0.18	42.42
		16	20.21	37.25	0.18	42.36
Saudi Arabia	COP	1	7.24	6.28	0.09	86.39
		2	7.52	6.29	1.00	85.20
		4	8.09	6.24	4.09	81.58
		8	8.08	6.36	4.09	81.46
		16	8.08	6.36	4.09	81.46
	CODP	1	6.56	6.64	0.28	86.52
		2	6.82	6.64	1.24	85.30
		4	9.66	6.53	3.59	80.21
		8	9.78	6.56	3.67	79.98
		16	9.79	6.56	3.67	79.97
UAE	COP	1	0.09	1.76	0.01	98.14
		2	0.43	1.73	0.01	97.83
		4	0.44	1.73	0.01	97.82
		8	0.44	1.73	0.01	97.82
		16	0.44	1.73	0.01	97.82
	CODP	1	0.01	0.82	0.27	98.89
		2	0.89	0.84	0.34	97.93
		4	2.22	3.66	0.33	93.79
		8	3.20	4.96	1.18	90.66
		16	3.22	5.12	1.35	90.31

4.2. Symmetric or asymmetric response of stock market return

Figure 2 shows a different equity market response to both positive and negative oil price shocks. As can be seen in Figure 2, Iran and Saudi Arabia equity markets respond positively and statistically significant to the fall in the oil price shocks and this impact lasts at least 4 weeks in both of them. On the other word, there is an asymmetric response in case of Iranian and Saudi equity stock market return while Russian stock exchange return shows asymmetric response to the oil price shocks. Table 4-4 indicates that Russian stock market return has the accumulated positive response to decreasing of oil price while the aggregate response of market return to the hike of oil price is negative after 20 horizons. The most striking observation emerged through the comparison of the figures was that there had been no evidence regarding the sensitivity of equity return in Norway and UAE to any of the oil price shocks.

Table 4-5 presents that the shocks from stock market have greatest power in all countries in terms of explaining market return variation. In a general finding, majority of the oil exporting countries showed sensitivity only to one of the oil price shocks. It is worth to mention that Iran, Saudi Arabia, Russia and UAE market returns are more affected by the fall in national price of oil while this effect is totally reversed in the case of Norway. In the case of the stock market return variation of Saudi Arabia, it is apparent that oil factors and the world market are critical channels of roughly 20% of variation in the market.

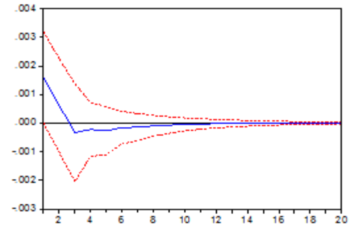
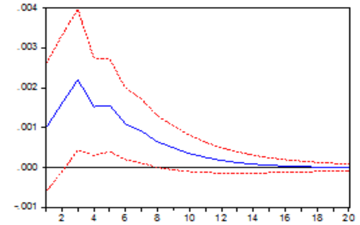
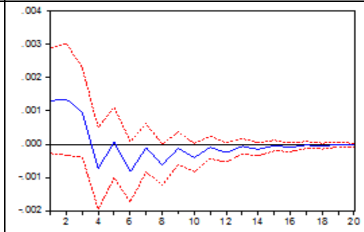
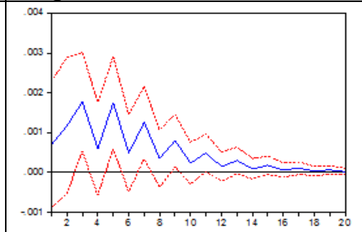
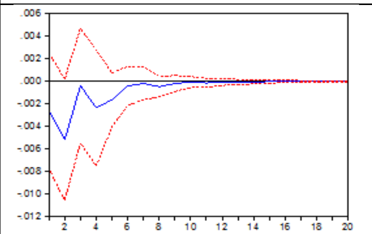
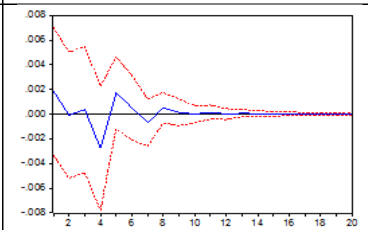
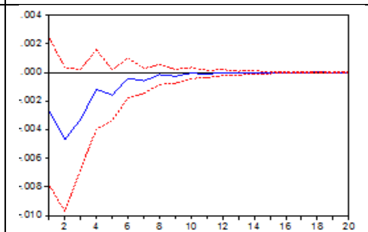
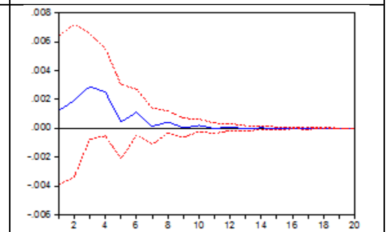
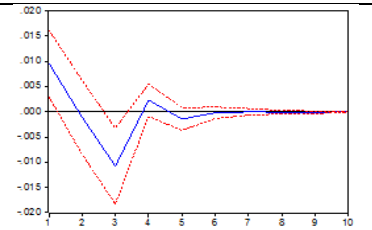
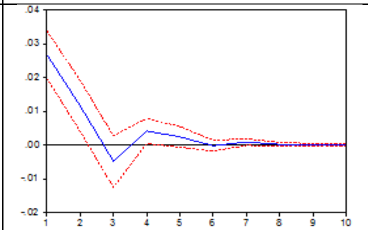
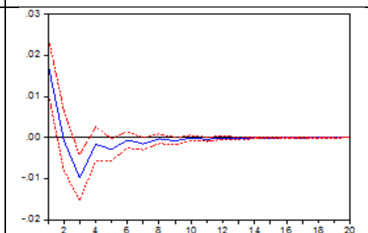
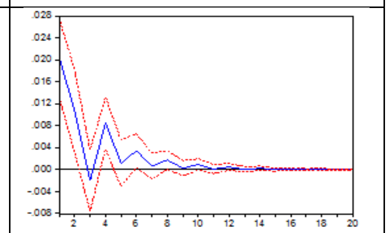
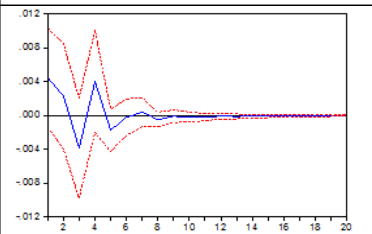
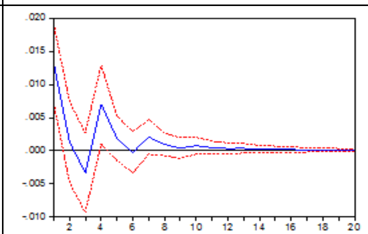
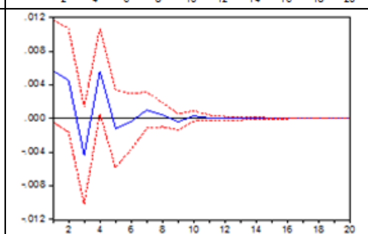
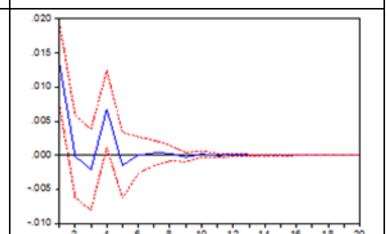
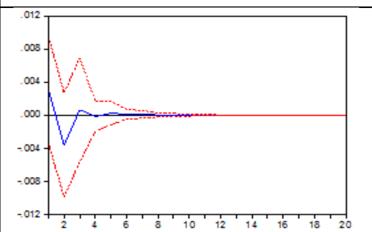
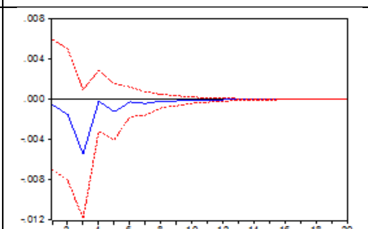
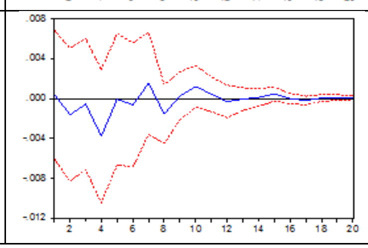
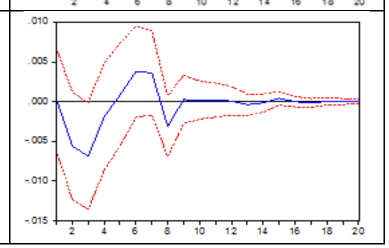
Stock market return response	**Oil price return shocks by COP identification**		**Oil price return shocks by CODP identification**	
	Positive shocks	**Negative shocks**	**Positive shocks**	**Negative shocks**
Iran				
Norway				
Russia				
Saudi Arabia				
UAE				

Figure 2

Stock market return response to the positive and negative oil price return shocks

Table 2

Accumulated impulse response function of stock market return to positive and negative oil price shocks

lag	RUSSIA				SAUDI ARABIA				U.A.E				IRAN				Norway			
	COP		CODP		COP		CODP		COP		CODP		COP		CODP		COP		CODP	
	negative	positive	negative	positive	negative	positive	negative	positive	negative	positive	negative	positive	negative	positive	negative	positive	negative	positive	negative	positive
1	0.027	0.010	0.021	0.018	0.013	0.005	0.006	0.014	-0.001	0.003	0.000	0.000	0.001	0.002	0.001	0.001	0.002	-0.003	0.001	-0.003
2	0.039	0.009	0.031	0.018	0.015	0.007	0.010	0.013	-0.002	-0.001	-0.005	-0.001	0.003	0.002	0.002	0.003	0.002	-0.008	0.003	-0.007
3	0.034	-0.002	0.029	0.008	0.011	0.003	0.006	0.011	-0.007	0.000	-0.012	-0.002	0.005	0.002	0.004	0.004	0.002	-0.008	0.006	-0.011
4	0.038	0.000	0.038	0.006	0.018	0.007	0.011	0.018	-0.008	0.000	-0.014	-0.006	0.006	0.002	0.004	0.003	-0.001	-0.011	0.009	-0.012
5	0.040	-0.001	0.039	0.003	0.020	0.005	0.010	0.017	-0.009	0.000	-0.013	-0.006	0.008	0.001	0.006	0.003	0.001	-0.012	0.009	-0.013
6	0.040	-0.002	0.042	0.003	0.020	0.005	0.010	0.017	-0.009	0.000	-0.010	-0.006	0.009	0.001	0.007	0.002	0.002	-0.013	0.010	-0.014
7	0.041	-0.002	0.043	0.001	0.022	0.005	0.011	0.017	-0.010	0.001	-0.006	-0.005	0.010	0.001	0.008	0.002	0.001	-0.013	0.010	-0.014
8	0.041	-0.002	0.045	0.001	0.023	0.005	0.011	0.017	-0.010	0.001	-0.009	-0.006	0.011	0.001	0.008	0.001	0.002	-0.013	0.011	-0.015
9	0.041	-0.002	0.045	0.000	0.023	0.005	0.011	0.017	-0.010	0.001	-0.009	-0.006	0.011	0.001	0.009	0.001	0.002	-0.013	0.011	-0.015
10	0.041	-0.002	0.046	0.000	0.024	0.005	0.011	0.017	-0.010	0.001	-0.009	-0.005	0.011	0.001	0.009	0.001	0.002	-0.014	0.011	-0.015
11	0.042	-0.002	0.046	-0.001	0.025	0.004	0.011	0.017	-0.010	0.001	-0.008	-0.004	0.012	0.001	0.010	0.001	0.002	-0.014	0.011	-0.015
12	0.042	-0.002	0.047	-0.001	0.025	0.004	0.011	0.017	-0.010	0.001	-0.008	-0.005	0.012	0.001	0.010	0.001	0.002	-0.014	0.011	-0.015
13	0.042	-0.002	0.047	-0.001	0.025	0.004	0.011	0.017	-0.010	0.001	-0.009	-0.005	0.012	0.001	0.010	0.001	0.002	-0.014	0.011	-0.015
14	0.042	-0.002	0.047	-0.001	0.025	0.004	0.011	0.017	-0.010	0.001	-0.009	-0.005	0.012	0.001	0.010	0.000	0.002	-0.014	0.011	-0.015
15	0.042	-0.002	0.047	-0.001	0.026	0.004	0.011	0.017	-0.010	0.001	-0.008	-0.004	0.012	0.001	0.010	0.000	0.002	-0.014	0.011	-0.015
16	0.042	-0.002	0.047	-0.001	0.026	0.004	0.011	0.017	-0.010	0.001	-0.008	-0.004	0.012	0.001	0.010	0.000	0.002	-0.014	0.011	-0.015
17	0.042	-0.002	0.047	-0.001	0.026	0.004	0.011	0.017	-0.010	0.001	-0.009	-0.004	0.012	0.001	0.011	0.000	0.002	-0.014	0.011	-0.015
18	0.042	-0.002	0.047	-0.001	0.026	0.004	0.011	0.017	-0.010	0.001	-0.009	-0.004	0.013	0.001	0.011	0.000	0.002	-0.014	0.011	-0.015
19	0.042	-0.002	0.047	-0.001	0.026	0.004	0.011	0.017	-0.010	0.001	-0.009	-0.004	0.013	0.001	0.011	0.000	0.002	-0.014	0.011	-0.015
20	0.042	-0.002	0.047	-0.001	0.026	0.004	0.011	0.017	-0.010	0.001	-0.009	-0.004	0.013	0.001	0.011	0.000	0.002	-0.014	0.011	-0.015

Table 3

Generalized variance decomposition of stock market return (asymmetric investigation)

		Period	Negative shocks	positive shocks	World market return	Industrial production growth	stock makret return
Iran	COP	1	0.55	1.44	0.15	0.47	97.38
Iran	COP	2	1.76	1.46	0.61	0.72	95.46
Iran	COP	4	4.52	1.32	1.32	0.83	92.01
Iran	COP	8	6.24	1.32	1.35	0.81	90.28
Iran	COP	16	6.44	1.32	1.36	0.81	90.07
Iran	CODP	1	0.27	0.96	0.19	0.51	98.07
Iran	CODP	2	0.90	1.71	0.83	0.88	95.68
Iran	CODP	4	2.25	2.09	1.35	0.99	93.31
Iran	CODP	8	4.15	2.42	1.51	0.97	90.96
Iran	CODP	16	4.55	2.52	1.54	0.96	90.43
Norway	COP	1	0.19	0.37	0.50	0.03	98.92
Norway	COP	2	0.18	1.74	1.13	0.10	96.85
Norway	COP	4	0.55	1.94	1.84	1.48	94.18
Norway	COP	8	0.74	2.07	2.00	1.57	93.61
Norway	COP	16	0.74	2.07	2.00	1.57	93.61
Norway	CODP	1	0.08	0.40	0.31	0.01	99.20
Norway	CODP	2	0.27	1.52	0.74	0.06	97.41
Norway	CODP	4	1.01	2.08	0.85	0.43	95.63
Norway	CODP	8	1.09	2.23	0.86	0.43	95.39
Norway	CODP	16	1.09	2.23	0.86	0.43	95.38
Russia	COP	1	19.04	2.46	32.96	0.01	45.53
Russia	COP	2	21.09	2.32	32.29	0.16	44.14
Russia	COP	4	21.20	5.09	31.04	0.18	42.50
Russia	COP	8	21.30	5.12	31.01	0.18	42.39
Russia	COP	16	21.30	5.12	31.01	0.18	42.39
Russia	CODP	1	11.19	8.73	35.31	0.01	44.76
Russia	CODP	2	13.29	8.16	34.83	0.09	43.62
Russia	CODP	4	14.51	10.16	33.39	0.09	41.85
Russia	CODP	8	14.79	10.34	33.17	0.09	41.61
Russia	CODP	16	14.81	10.36	33.15	0.09	41.59
Saudi Arabia	COP	1	6.62	0.76	7.17	0.13	85.32
Saudi Arabia	COP	2	6.59	0.95	7.19	1.13	84.13
Saudi Arabia	COP	4	8.31	1.99	6.98	3.26	79.45
Saudi Arabia	COP	8	8.57	2.10	7.02	3.31	79.00
Saudi Arabia	COP	16	8.61	2.10	7.02	3.32	78.94
Saudi Arabia	CODP	1	7.10	1.24	6.73	0.09	84.84
Saudi Arabia	CODP	2	6.97	1.99	6.80	0.90	83.33
Saudi Arabia	CODP	4	8.25	3.65	6.63	3.63	77.85
Saudi Arabia	CODP	8	8.30	3.73	6.65	3.69	77.64
Saudi Arabia	CODP	16	8.30	3.74	6.65	3.69	77.62
UAE	COP	1	0.01	0.32	1.88	0.00	97.80
UAE	COP	2	0.08	0.74	1.89	0.00	97.29
UAE	COP	4	1.05	0.74	1.86	0.16	96.19
UAE	COP	8	1.11	0.74	1.86	0.16	96.13
UAE	COP	16	1.11	0.74	1.86	0.16	96.13
UAE	CODP	1	0.00	0.01	1.27	0.31	98.41
UAE	CODP	2	1.06	0.10	1.28	0.36	97.21
UAE	CODP	4	2.62	0.55	3.91	0.35	92.56
UAE	CODP	8	3.67	0.69	4.91	1.30	89.43
UAE	CODP	16	3.67	0.75	5.11	1.45	89.02

4.3. Volatility transmission

Table 4-6presents the empirical result of the impact of oil price return volatility transmission to the stock market return. The oil price is introduced in both domestic (CODP) and US (COP) dollar per barrel. The approach used by Wong, Chau et al. (2007) and Hammoudeh and Aleisa (2004) has been utilized due to the simplicity in explanation. The main concern of this part is to examine the effect of oil market volatility on the stock market return volatility which is shown by g_{os}. It can be said that the significance of g_{os} is an indicator of volatility transmission from oil price return to the stock market return. As is explained in the methodology section, significance of a_{os} shows the effect of the oil price shocks in period T on the stock market return volatility in T+1.

From the data in table 4-6, it is apparent that all markets return's volatility are mostly sensitive to the lagged impact of its own shocks and variance. The findings of BEKK GARCH analysis can be explained under three groups. Firstly, cross variable analysis of volatility in UAE shows that shocks in oil price return and volatility of oil price return have insignificant effect on risk performance of equity market return. As depicted in Figure-3, the time varying correlation of volatility also support the findings of Table 4-6. Secondly, by considering Saudi market, the finding of indirect impact of oil features implies that there is no significant evidence on volatility spillover of oil price return to stock market return at 10% level. Another important finding is that a_{os} responses significantly for both national and US dollar value of oil per barrel at 5% level. This finding implies that fluctuation of stock market return is affected by the lagged shock to the oil price. Time varying correlation of volatility of the stock market return and oil price return (Figure 3) shows ultimately 80% correlation among the data for the period of study. The result from the last group of countries (Iran, Norway and Russia) illustrates that volatility of oil price return has spillover effect on the stock market return. It is worth noting that, in case of Iranian market, volatility spillover is only supported significantly for crude oil price identification in US dollar. Furthermore, the Russian stock market return is more fluctuated for the lagged impact oil price shocks (a_{os}) than volatility of oil price return (g_{os}), ($|0.34|>|0.19|$ in domestic and $|0.64|>|0.36|$ in US currency).

Table 4
Bivariate BEKK GARCH (1, 1) results

	Iran		Norway		Russia		Saudi Arabia		UAE	
	COP	**CODP**	**COP**	**CODP**	**COP**	**CODP**	**COP**	**CODP**	**COP**	**CODP**
μ_s	-0.00044	-0.0016*	0.0049***	0.006095***	0.00761***	0.01049***	0.00367***	0.003698*	0.00024	-0.00100
μ_o	0.00456*	0.0030	0.0054***	0.007367***	0.00431***	0.01128***	0.00488**	0.004858**	0.00414	0.00458*
c_{ss}	0.001719	0.0068***	0.0135***	0.016342***	0.0097***	-0.0139**	0.01148***	0.011569***	0.02610***	0.02349***
c_{os}	0.012098***	0.0003	-0.0067	0.003978	-0.00739**	-0.00474	0.00094	0.001012	-0.00439	-0.0099***
c_{oo}	4.3E-07	0.0084**	0.0019	0.000000	0.00000	0.01077**	0.01166***	0.011624***	0.00783*	0.00000
a_{ss}	0.366662***	0.6340***	0.5239***	0.351496**	0.56208***	0.25952***	0.61615***	0.616214***	0.56131***	0.52548***
a_{s0}	-0.26426	0.2810	0.2398***	0.071909	0.28670***	0.06368	-0.02092	-0.018904	-0.00633	-0.04732
a_{os}	0.046014***	0.0540***	0.0422	0.191017*	-0.3457***	0.64510***	0.13103**	0.126617**	-0.08550	-0.05779
a_{oo}	0.187048***	0.2415***	-0.0506	0.118789	-0.07045	0.26564***	0.28684***	0.286656***	0.27405***	0.30223***
g_{ss}	0.782873***	0.6438***	-0.784***	0.704582***	0.77518***	-0.5201***	0.78272***	0.783306***	0.68001***	-0.7258***
g_{so}	1.822418***	-0.3146	-0.0789	1.309395***	-0.172***	-0.851****	0.04372	0.042345	-0.00598	0.04504
g_{os}	-0.18676***	-0.0598	0.6155**	0.085679***	0.19635***	-0.3616***	-0.02556	-0.025249	0.09247*	0.13911
g_{oo}	0.667765***	-0.9269***	0.9880***	-0.8782***	0.99214***	0.72680***	0.91262***	0.913269***	0.94168***	0.92811***
Log likelihood	1284.529	1290.121	1068.995	1055.24	962.44	952.88	963.87	963.620	926.38	923.940

Notes: (*),(**) and (***) denote the respective 10%, 5%and 1% significance level. CODP and COP are domestic oil price return and oil price return in US dollar.

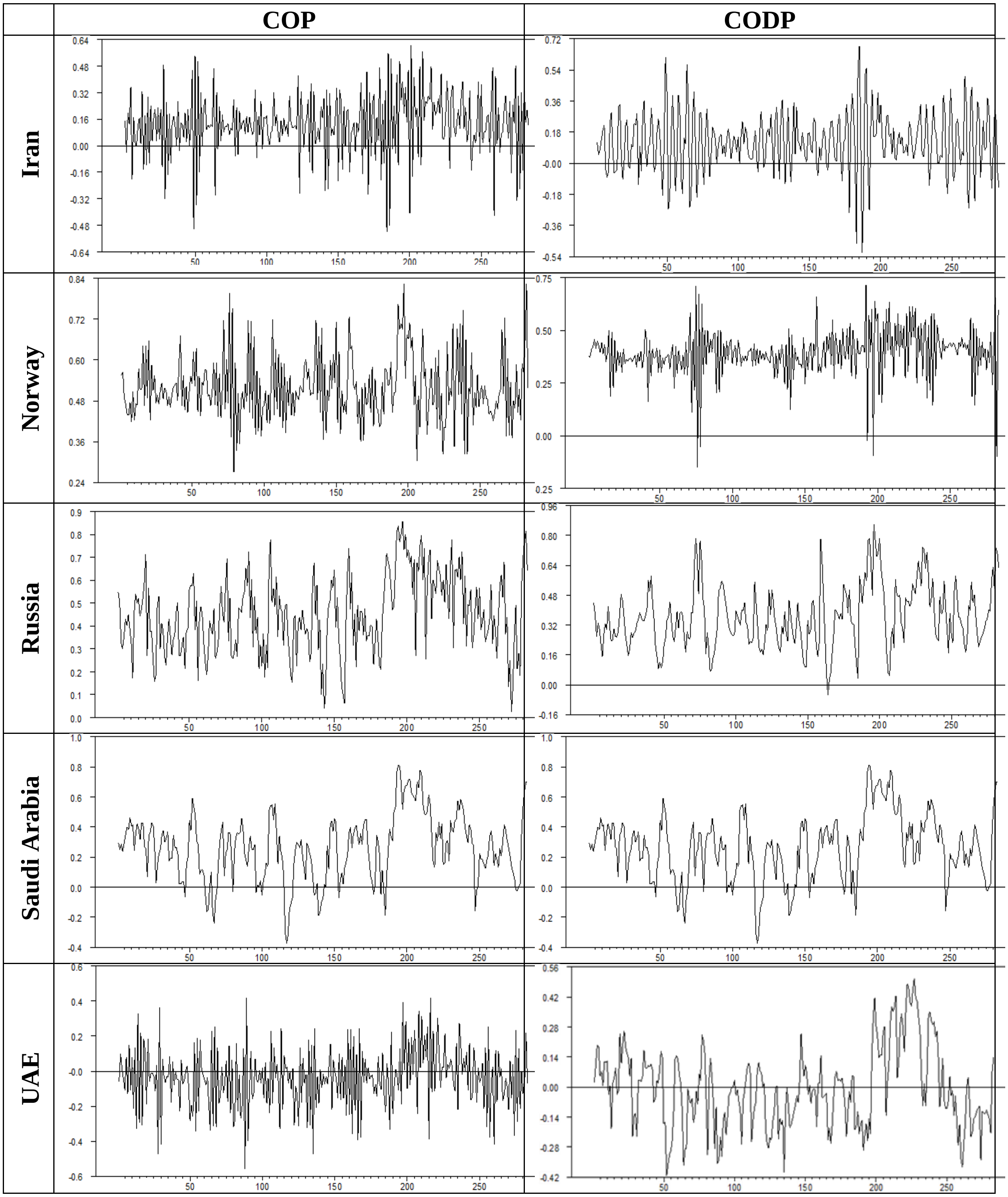


Figure 3

Time varying variance correlation of stock market return and oil price return under domestic oil price return (CODP) and US Dollar oil price return

These observations suggest that Russian stock market performance is highly dependent on the oil price shocks and volatility. Oil price return volatility is found to be affected significantly by variation of the stock market return. Figure 3 consistently demonstrates that conditional variation of Oslo and Moscow stock market return and oil price return are positively correlated for the entire period of analysis and it reached the peak of 82% for US dollar value of oil per barrel.

5. Conclusion

This study set out to determine the central importance of oil factor in explaining the behavior of the stock market return in the five major net oil exporting countries. The main aim was to evaluate the dynamic reaction of stock market to oil factors (the oil shock, oil price volatility, surge and fall in oil price) using weekly data. The findings of this research can be divided into three main aspects; firstly, oil price changes-stock market return, secondly, asymmetric reaction of the stock market return- fall and surge in oil price and lastly, oil price variation and the stock market volatility.

The first significant finding merged from this study is that just three countries of Russia, Iran and Saudi Arabia are positively affected by the oil price changes shocks. Evidence from this study suggests that oil price changes shocks are not an important factor in stock market response of UAE and Norway. Comparing the findings under both COP and CODP criteria demonstrates that reaction of markets return to the CODP oil price shocks is more volatile and lasts for longer horizons in comparison to the CODP identification. Contrary to expectations, this study did not find a significant response to positive or negative oil price shocks in stock market performances of UAE and Norway. The relevance of asymmetric market reaction is clearly supported by the current findings of Iran and Saudi markets, while the RUSSIA stock market return has a symmetric response to the oil price shocks. The last major finding is that only three out of five markets are affected by the volatility spillover of oil price return based on a weekly analysis.

The empirical findings of this study throw light on pivotal role of crude oil price which is accounted as an important factor in risk assessment of stock market return for most oil exporting countries, albeit the effects are dynamically and adversely different among the countries. In contrary to the previous studies that highlighted the role of increasing oil price on the markets, this study found that in the oil exporting countries securities markets are mostly affected by the fall in the oil price shocks. The oil price change shocks in the market return of oil exporting countries

can be utilized in better identification of the systematic risk under fluctuation of oil market. In this regard, measure of the asymmetric impact of the oil price shocks can help to improve predictive power of market participants, investor and hedgers to the overall market behavior in terms of the oil price shocks in any direction. The findings of BEKK GARCH analysis can be a good pattern of lag-lead behavior of the stock market return under the variations and the shocks of oil price. Its implication would be pleasant and useful in short-term based stock market analysis. The present study, however, makes several noteworthy suggestions about the relationship of market behavior in countries which are highly dependent on one commodity or industry.

Overall, by the comparison of the findings of this study with the findings of the previous ones, it can be concluded that it is impossible to introduce a similar behavior among all financial markets in the oil exporting countries. The reason could be explained in terms of different capital structure of the stock markets, industries' dependence on oil as well as existence of the conditions of economic and political stability in these countries. In other words, the oil exporting countries reveal various degrees of sensitivity to oil price changes.

6. References

Aloui, C., et al. (2012). "Assessing the impacts of oil price fluctuations on stock returns in emerging markets." Economic Modelling**29**(6): 2686-2695.

Apergis, N. and S. M. Miller (2009). "Do structural oil-market shocks affect stock prices?" Energy Economics**31**(4): 569-575.

Basher, S. A. and P. Sadorsky (2006). "Oil price risk and emerging stock markets." Global Finance Journal**17**(2): 224-251.

Bastianin, A. and M. Manera (2015). "How does stock market volatility react to oil shocks?".

Bhattacharya, P., et al. (2006). Time-varying hedge ratios: an application to the Indian stock futures market. Econometric Society Australasian Meetings Papers, [Econometric Society Australasian Meetings].

Bjørnland, H. C. (2009). "Oil price shocks and stock market booms in an oil exporting country." Scottish Journal of Political Economy**56**(2): 232-254.

Bloom, N. (2013). Fluctuations in uncertainty, National Bureau of Economic Research.

Campbell, J. Y. (1990). A variance decomposition for stock returns, National Bureau of Economic Research.

Chung, S.-K. (2008). "The Out-of-Sample Forecasting of Hedged Portfolio Variances using Bivariate Mixed Normal GARCH Models." Journal of economic research**13**(2): 325-347.

Ciner, C. (2001). "Energy shocks and financial markets: nonlinear linkages." Studies in Nonlinear Dynamics & Econometrics**5**(3).

Cong, R.-G., et al. (2008). "Relationships between oil price shocks and stock market: An empirical analysis from China." Energy Policy**36**(9): 3544-3553.

Cronin, D., et al. (2011). "Money growth, uncertainty and macroeconomic activity: a multivariate GARCH analysis." Empirica**38**(2): 155-167.

Cunado, J. and F. P. de Gracia (2014). "Oil price shocks and stock market returns: Evidence for some European countries." Energy Economics**42**: 365-377.

Davis, S. J. and J. Haltiwanger (2001). "Sectoral job creation and destruction responses to oil price changes." Journal of monetary economics**48**(3): 465-512.

Degiannakis, S., et al. (2013). "Oil and stock returns: Evidence from European industrial sector indices in a time-varying environment." Journal of International Financial Markets, Institutions and Money**26**: 175-191.

Dickey, D. A. and W. A. Fuller (1979). "Distribution of the estimators for autoregressive time series with a unit root." Journal of the American statistical association**74**(366a): 427-431.

Driesprong, G., et al. (2008). "Striking oil: Another puzzle?" Journal of Financial Economics**89**(2): 307-327.

Eika, T. and K. A. Magnussen (2000). "Did Norway gain from the 1979–1985 oil price shock?" Economic Modelling**17**(1): 107-137.

Engle, R. F., et al. (2013). "Stock market volatility and macroeconomic fundamentals." Review of Economics and Statistics**95**(3): 776-797.

Engle, R. F. and K. F. Kroner (1995). "Multivariate simultaneous generalized ARCH." Econometric theory**11**(01): 122-150.

Faff, R. W. and T. J. Brailsford (1999). "Oil price risk and the Australian stock market." Journal of Energy Finance & Development**4**(1): 69-87.

Gjerde, Ø. and F. Saettem (1999). "Causal relations among stock returns and macroeconomic variables in a small, open economy." Journal of International Financial Markets, Institutions and Money**9**(1): 61-74.

Guidi, M. G., et al. (2006). "The effect of OPEC policy decisions on oil and stock prices." OPEC review**30**(1): 1-18.

Guo, H. and K. L. Kliesen (2005). "Oil price volatility and US macroeconomic activity." REVIEW-FEDERAL RESERVE BANK OF SAINT LOUIS**87**(6): 669.

Hamilton, J. D. (1983). "Oil and the macroeconomy since World War II." The Journal of Political Economy: 228-248.

Hamilton, J. D. (1996). "This is what happened to the oil price-macroeconomy relationship." Journal of monetary economics**38**(2): 215-220.

Hammoudeh, S. and E. Aleisa (2004). "Dynamic relationships among GCC stock markets and NYMEX oil futures." Contemporary Economic Policy**22**(2): 250-269.

Hammoudeh, S. and K. Choi (2006). "Behavior of GCC stock markets and impacts of US oil and financial markets." Research in International Business and Finance**20**(1): 22-44.

Hammoudeh, S. and K. Choi (2007). "Characteristics of permanent and transitory returns in oil-sensitive emerging stock markets: The case of GCC countries." Journal of International Financial Markets, Institutions and Money**17**(3): 231-245.

Hammoudeh, S., et al. (2004). "Relationships among US oil prices and oil industry equity indices." International Review of Economics & Finance**13**(4): 427-453.

He, L. T. and K. Casey (2015). "Forecasting ability of the investor sentiment endurance index: The case of oil service stock returns and crude oil prices." Energy Economics**47**: 121-128.

Herrera, A. M., et al. (2014). "Forecasting Crude Oil Price Volatility."

Huang, R. D., et al. (1996). "Energy shocks and financial markets." Journal of Futures Markets**16**(1): 1-27.

Jimenez-Rodriguez, R. (2008). "The impact of oil price shocks: evidence from the industries of six OECD countries." Energy Economics**30**(6): 3095-3108.

Jones, C. M. and G. Kaul (1996). "Oil and the stock markets." The Journal of Finance**51**(2): 463-491.

Kaneko, T. and B.-S. Lee (1995). "Relative importance of economic factors in the US and Japanese stock markets." Journal of the Japanese and International Economies**9**(3): 290-307.

Kang, W. and R. A. Ratti (2013). "Structural oil price shocks and policy uncertainty." Economic Modelling**35**: 314-319.

Karanasos, M. and J. Kim (2005). "The inflation-output variability relationship in the G3: a bivariate GARCH (BEKK) approach." Risk Letters**1**(2): 17-22.

Kilian, L. and C. Park (2009). "The impact of oil price shocks on the us stock market*." International Economic Review**50**(4): 1267-1287.

Kwiatkowski, D., et al. (1992). "Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?" Journal of econometrics**54**(1): 159-178.

Lee, K., et al. (2011). "Oil price shocks, firm uncertainty, and investment." Macroeconomic Dynamics**15**(S3): 416-436.

Lee, K., et al. (1995). "Oil shocks and the macroeconomy: the role of price variability." The Energy Journal: 39-56.

Lee, Y.-H. and J.-S. Chiou (2011). "Oil sensitivity and its asymmetric impact on the stock market." Energy**36**(1): 168-174.

Maghyereh, A. (2004). "Oil price shocks and emerging stock markets: A generalized VAR approach." International Journal of Applied Econometrics and Quantitative Studies**1**(2): 27-40.

Malik, F. and S. Hammoudeh (2007). "Shock and volatility transmission in the oil, US and Gulf equity markets." International Review of Economics & Finance**16**(3): 357-368.

Mallik, G. and A. Chowdhury (2011). "Effect of inflation uncertainty, output uncertainty and oil price on inflation and growth in Australia." Journal of Economic Studies**38**(4): 414-429.
Mork, K. A. (1989). "Oil and the macroeconomy when prices go up and down: an extension of Hamilton's results." Journal of Political Economy: 740-744.
Nandha, M. and R. Faff (2006). "Short-run and long-run oil price sensitivity of equity returns: The South Asian markets." Review of Applied Economics**2**(2).
Nandha, M. and R. Faff (2008). "Does oil move equity prices? A global view." Energy Economics**30**(3): 986-997.
Narayan, P. K. and S. S. Sharma (2011). "New evidence on oil price and firm returns." Journal of Banking & Finance**35**(12): 3253-3262.
Ng, S. and P. Perron (2001). "Lag length selection and the construction of unit root tests with good size and power." Econometrica: 1519-1554.
Oberndorfer, U. (2009). "Energy prices, volatility, and the stock market: Evidence from the Eurozone." Energy Policy**37**(12): 5787-5795.
Odusami, B. O. (2009). "Crude oil shocks and stock market returns." Applied financial economics**19**(4): 291-303.
Papapetrou, E. (2001). "Oil price shocks, stock market, economic activity and employment in Greece." Energy Economics**23**(5): 511-532.
Park, J. and R. A. Ratti (2008). "Oil price shocks and stock markets in the US and 13 European countries." Energy Economics**30**(5): 2587-2608.
Rapach, D. E. (2001). "Macro shocks and real stock prices." Journal of Economics and Business**53**(1): 5-26.
Sadorsky, P. (1999). "Oil price shocks and stock market activity." Energy Economics**21**(5): 449-469.
Sadorsky, P. (2001). "Risk factors in stock returns of Canadian oil and gas companies." Energy Economics**23**(1): 17-28.
Stout, B. A. (2012). Handbook of energy for world agriculture, Elsevier.
Wong, S. K., et al. (2007). "Volatility transmission in the real estate spot and forward markets." The Journal of Real Estate Finance and Economics**35**(3): 281-293.